

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

REMARKS/ARGUMENT

Claims 14-21 and 33-40 are pending after entry of this Amendment.

Rejections under 35 USC §112

Claims 37-40 were rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. According to the Office, the term "high aspect ratio" in claim 37 is a relative term which renders the claim indefinite. Applicants respectfully traverse this rejection and request reconsideration.

As Applicants have repeatedly asserted, and illustrated with examples from prior art, including the very prior art used by the Examiner in rejecting claims of the instant application, the term "high aspect ratio" is a *term of art*. One of ordinary skill in the art of semiconductor manufacturing in general, and of etch technology to be more specific, clearly understands the meaning, intent, and scope of a high aspect ratio process. Just as single words of many multi-word phrases, or terms of art, can be rendered uncertain when removed from the context of the term or phrase, if the Office insists on analyzing "high" instead of Applicants' claimed "high aspect ratio," uncertainty results. Applicants respectfully request reconsideration, and in the reconsideration, Applicants respectfully request the Office to consider the entire claimed term "high aspect ratio" as generally known to indicate deep and narrow etch geometries. Applicants further request reconsideration in the context of the Applicants' claims. Applicants are claiming a method for high aspect ratio semiconductor etching. In other words, Applicants are claiming a method for a particular type of etching process, the particular type of etching process being generally known and understood by the term of art, "high aspect ratio." Whether or not Applicants define the word "high," in the term "high aspect ratio," one of ordinary skill in the art is reasonably apprised of the scope of the claimed invention, that of a method.

Applicants therefore respectfully request that the §112 rejection be withdrawn.

Rejections under 35 USC §103

Claims 33-35, 37-38, and 40 were rejected under 35 USC §103(a) as being unpatentable over Tomita et al. in view of admitted prior art. Applicants respectfully

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

traverse this rejection, and request reconsideration in light of the following argument, supported by a Declaration Under 37 CFR §1.132 attached hereto.

Tomita et al. disclose a plasma etching system including a process chamber for enclosing a plasma, and a means for evacuation of the plasma from the chamber. A substrate is supported on a chuck electrode, and a shower electrode is positioned facing the chuck electrode. The shower electrode has a plurality of small holes. A power source is provided to strike a plasma between the chuck electrode and the shower electrode. Plasma forming gases are supplied through the small holes into the space between the chuck electrode and the shower electrode. The gas is supplied through the small holes at a mass flow rate of at least 620 kg/m²/hr.

Applicants' independent claim 33 claims a method of processing a semiconductor wafer. The method includes providing a processing chamber. The processing chamber is in an operational state and includes a top electrode, a wafer support chuck that has the semiconductor wafer positioned thereon, and a pair of RF power sources. The method then includes striking a plasma within a plasma region of the processing chamber, and causing a first surface of a plasma sheath to shift into electrode openings of the top electrode. The plasma sheath defines the first surface of the plasma sheath next to the top electrode and a second surface of the plasma sheath over a surface of the semiconductor wafer.

Applicants' independent claim 37 claims a method for high aspect ratio semiconductor etching. The method includes providing a plasma etch processing chamber which includes a top electrode, a wafer support chuck, and a pair of RF power supplies, and is configured in an operational state. A plasma is struck in a plasma region of the chamber. The plasma region is defined between an electrode surface of the top electrode and a wafer surface of a wafer which is positioned on the wafer support chuck. A first surface of a plasma sheath which is proximate to the top electrode is caused to shift into electrode openings of the top electrode. A bias voltage over the wafer surface is increased while the bias voltage over the electrode surface of the top electrode is decreased without increasing a plasma density.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

reference or to combine the reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references when combined must teach or suggest all the claim limitations. (MPEP §2143). Applicants respectfully submit the Office has failed to establish a *prima facie* case of obviousness.

Applicants again point out that the Office has re-stated: "Note that inherently the plasma sheath will form within the inlet opening 55 to form the second plasma sheath surface area since the openings have an opening diameter of 0.6 mm (see Applicants' specification at page 13, lines 22-24 and col. 5-line 3-5 of Tomita et al.)" The cited sections recite only that Applicants' claimed invention describes electrode openings of at least 0.5 mm, and that Tomita et al. disclose small holes having a diameter of 0.6 mm. The Office appears to have established that there is a common or similar feature. This alone, however, does not support an assertion of *inherency*. In a prior Amendment, Applicants submitted that "the office has rejected the pending method claims based on an assertion that the size of the electrode openings alone inherently will provide for a formed plasma sheath to shift into the electrode openings, increase the surface area of the plasma sheath adjacent to the electrode openings, and generate an increase in bias voltage directed at the surface of the wafer. Applicants respectfully submit that the Office has failed to appreciate the dynamics of plasma physics, and that the size of the electrode opening alone will not result in the method disclosed and claimed by Applicants. The size of the electrode openings is but one parameter or feature of the presently claimed method. It is not a valid assumption to conclude that any electrode having electrode openings of a particular size (in the instant application the size is recited to be at least 0.5mm) will result in a plasma shift into the electrode openings." In the Final Office Action, the Office simply replies that "as taught by applicant, openings of 0.5 mm or greater will form a plasma sheath (see page 13, lines 22-24 of applicant's specification), the 0.6 mm openings in Tomita et al. will inherently produce the desired effect."

The Office has apparently misconstrued Applicants' specification to state that the size of the electrode opening alone will provide for a plasma sheath to shift into the electrode openings. This is not what the Applicants have disclosed or suggested. Further, as evidenced by the attached Declaration, one of ordinary skill in the art would not accept that the size of the electrode opening alone would result in a shift of the plasma sheath. Applicants respectfully submit that, as recited in the MPEP at §2112, "The establish

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill.'" Further, "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." Applicants respectfully submit that the Office has failed to support the asserted inherency, and as shown in the attached Declaration, the asserted inherency does not flow from the teachings of the applied prior art.

As previously submitted by Applicants, and as further supported in the attached Declaration, the Tomita et al. apparatus is constructed in such a manner as to prevent plasma flow into the electrode openings, and Tomita et al. teach away from any possibility of such plasma flow. As illustrated in Figure 4, and described at col. 5, lines 14-20, the Tomita et al. apparatus includes a small hole 55b formed in the cathode plate 54 which is smaller than a small hole 55a formed in the cooling plate 53. Gas flowing through the small hole 55 as taught by Tomita et al. effectively prevents the plasma formed between the chuck electrode and the shower electrode from flowing back up into the small hole 55, or shifting into the small hole 55. Further, as supported in the attached Declaration, such plasma flow is *undesirable* in an apparatus as disclosed by Tomita et al.

For at least the above reasons, Applicants submit that independent claims 33 and 37 are patentable over Tomita et al. in view of admitted prior art under 35 USC §103(a). Dependent claims 34-35, 38, and 40, each of which depends directly or indirectly from one of independent claims 33 and 37 are patentable for at least the same reasons. Applicants submit that the Office has failed to establish a *prima facie* case of obviousness for at least the reasons that the referenced prior art, as apparently suggested to be modified, does not disclose each and every feature as claimed by applicants, that the modification(s) as suggested by the Office would render the Tomita et al. reference unsatisfactory for its intended purpose, and one of ordinary skill in the art would not have a reasonable expectation of success since the modification(s) as suggested would probably result in plasma light-up either inside of the hole or behind the electrode. Applicants therefore respectfully request the §103 rejection be withdrawn.

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

Claims 14-21, 36, and 39 were rejected under 35 USC §103(a) as being unpatentable over Tomita et al., in view of Admitted prior art as applied above with respect to claims 33-35, 37-38, and 40, and further in view of Chang et al. (U.S. Patent No. 4,854,263). Applicants respectfully traverse this rejection, and request reconsideration in light of the following argument supported by the Declaration under 37 CFR §1.132 attached hereto as Appendix A.

Applicants' independent claims 33 and 37 are described above. Applicants' independent claim 14 claims a method for processing a semiconductor wafer through plasma etching operations. In a chamber for processing a semiconductor wafer through plasma etching operations, the chamber being in an operational state and including a support chuck for holding the semiconductor wafer, a pair of RF power sources, and a top electrode, the method for processing a semiconductor wafer through plasma etching operations includes striking a plasma in a plasma region of the chamber, and generating an increase in bias voltage directed at a wafer surface of the semiconductor wafer and a decrease in bias voltage directed at the top electrode. The top electrode is claimed as having a center region, a first surface and a second surface. The first surface has an inlet that is configured to receive processing gases from a source that is external to the chamber, and to flow the processing gases into the center region. The second surface has a plurality of gas feed holes that lead to a plurality of electrode openings. The plurality of electrode openings have electrode opening diameters that are greater than gas feed hole diameters of the plurality of gas feed holes. The plurality of electrode openings are configured to define the second surface which is located over the wafer surface of the semiconductor wafer. When a plasma is struck in the plasma region defined between the second surface and the wafer surface, the plasma defines a first plasma sheath surface that has a first plasma sheath surface area that is proximate to the wafer surface, and a second plasma sheath surface that has a second plasma sheath surface area that is proximate to the second surface. The second plasma sheath surface area is greater than the first plasma sheath surface area.

Contrary to the Office's assertion that the Tomita et al. reference fails to expressly disclose where the electrode opening diameters are greater than the gas hole feed diameters, Tomita et al. illustrate in Figure 4, and describe in the associated text (see col. 5, lines 14-20) that a small hole 55b formed in the cathode plate 54 which is smaller than

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

a small hole 55a formed in the cooling plate 53. If the Tomita et al. structure were to be modified in accordance with the electrode and gas feed openings as taught by Chang et al., the principle of operation of the Tomita et al. apparatus would be changed in such a manner as to render the Tomita et al. apparatus ineffective or inoperable for its intended purpose. In accordance with MPEP §2143, such a change in the principle of operation is insufficient to render the claims *prima facie* obvious.

Tomita et al. disclose an apparatus and structure to *prevent* plasma from flowing into the small holes 55b. As stated at col. 2, lines 46-52, "The particular gas supply system employed in the present invention permits suppressing the plasma polymerization within the small holes, with the result that a polymer is unlikely to be deposited on the circumferential wall of the small hole. Even if a polymer is formed, the polymer is blown away by the gas stream flowing at a high speed." If the asserted combination would allow plasma flow into the small holes, then the polymerization formation sought to be prevented and overcome would be re-introduced. Similarly, in a re-formed electrode and gas feed hole structure as proposed, a primary principle of operation of the Tomita et al. structure is not only modified, but defeated. Although the Office asserts that such a combination would be obvious to enhance dissociation and reactivity of the gases, to do so would not only modify the principle of operation of the apparatus, but would defeat the principle of operation. In order to achieve and maintain the high speed gas flow taught by Tomita et al., the disclosed and illustrated structure must be maintained. Tomita et al. address gas dissociation and reactivity by use of buffer plates (as pointed out by the Examiner) and baffle plate 50. The asserted modification could not achieve and maintain the high speed gas flow, and therefore the asserted modification and combination would render the prior art unsatisfactory for its intended purpose.

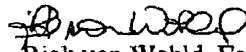
The asserted combination at least fails to teach all the claim limitations, and fails to establish a requisite motivation for combination since the combination would change the principle of operation of the Tomita et al. apparatus. Applicants therefore submit that independent claims 14, 33, and 37 are patentable under 35 USC §103(a) over Tomita et al. in view of admitted prior art and further in view of Chang et al. for at least the above reasons. Dependent claims 15-21, 36, and 39, each of which depends directly or indirectly from one of independent claims 14, 33, and 37 are likewise patentable for at least the same reasons. Applicants respectfully request the §103 rejection be withdrawn.

Appl. No. 09/611,037
Amdt. dated September 4, 2003
Reply to Final Office Action of June 04, 2003

In view of the foregoing, Applicants respectfully request reconsideration of claims 14-21 and 33-40. Applicants further request entry of this Response as providing clarifying and supporting evidence that place the application in condition for allowance. Even if the Office were to maintain some or all of the rejections replied to herein, this Response sufficiently clarifies issues to place the application in better form for appeal.

Applicants submit that all claims are in condition for allowance. Accordingly, a notice of allowance is respectfully requested. If Examiner has any questions concerning the present Response, the Examiner is kindly requested to contact the undersigned at (408) 749-6900, ext. 6905. If any additional fees are due in connection with filing this amendment, the Commissioner is also authorized to charge Deposit Account No. 50-0805 (Order No. LAM1P077A). A copy of the transmittal is enclosed for this purpose.

Respectfully submitted,
MARTINE & PENILLA, L.L.P.


Rick von Wohld, Esq.
Reg. No. 48,018

MARTINE & PENILLA, LLP
710 Lakeway Drive, Suite 170
Sunnyvale, California 94085
Customer Number 25920